STUDIES ON FUNGITOXICITY OF A COPPER BASED COMPOUND S-3

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Fungitoxicity studies of a new copper-based compound, S-3, were carried out in comparison with another imported copper compound against some plant pathogenic fungi. It was found that the compound S-3 was more effective in controlling the growth of *Helminthosporium anomalum* than Colloidal copper but was equally effective against *Fusarium solani*.

The effectiveness of S-3 against *Fusarium dimerum* and *Alternaria tenuis* was found to be less as compared to Colloidal copper. This may be due to more resistant nature of these two fungi towards compound S-3.

The present studies, show that S-3 may be recommended for further exploitation as a commercial fungicide.

Introduction

Certain cations particularly copper, mercury, and zinc are known for a long time for their toxic action against most fungi. The use of ordinary inorganic salts of these metals is limited due to their ability of making solution with water. Metallic soaps of fatty and synthetic acids being insoluble in water have a definite advantage in this regard.[1] Copper naphthenate has been reported to have the property of preserving cellulosic fabrics and wood.[2] Copper oleate has particularly been mentioned in the literature for its fungicidal and insecticidal activity.[3] The availability of oleic acid in Pakistan for making copper oleate is almost nil because of lack of proper facilities. The copper soap of castor oil, referred to as S-3 here, the chief constituent of which is ricinoleic acid (85-90%), has been tested for its fungicidal activity. Other known substances were also studied for comparison in test experiments. The soap was made by the well-known process of precipitation.[4,5] Triethanolamine soap of castor fatty acids was used to emulsify the fungicide.

Experimental

Preliminary screening of S-3 was carried out using the poisoned food technique[6] with solid media as a base. Synthetic nutrient medium, Czapek's Dox agar, was used throughout these experiments.

The different constituents of the medium, including KH_2PO_4, were dissolved and 240.0, 237.0, 228.0,216.0 and 192.0 ml of the solution were poured into 500 ml conical flasks. To each flask 4.8 g of powdered agar was added. One flask with 240 ml solution was kept as control. The flasks were autoclaved at 15 lb pressure for 15 minutes, and then allowed to cool to 45°C. 3.0, 6.0, 12.0, 24.0 and 48.0 ml of the 8% emulsifiable concentrate of compound S-3 were added to each flask to obtain concentrations of 0.05, 0.1, 0.2, 0.4, 0.8 and 1.6% S-3 as recommended in Reference 7. Two flasks containing 1 and 2% of the emulsifier, used with compound S-3, were also taken. The flasks were shaken to mix the compound and the medium thoroughly. The medium was poured into 12 sterilized petri plates of 9-cm diameter and allowed to solidify. Out of 12 petri plates of each concentration, 3 were inoculated with 4 mm discs cut from the advancing edges of a 4-day old culture of *Alternaria tenuis* grown on potato dextrose agar and another 3 with *Fusarium solani* isolated from infected pototoes. Of the remaining 6 plates, 3 were inoculated with *Helminthosporium anomalum* and the last 3 with *Fusarium dimerum*. Controls were inoculated simultaneously and all the petri dishes were incubated at room temperature.

A similar set of experiment was carried out with colloidal copper to compare with compound S-3. These experiments were repeated about five times. Diameters of fungus colonies were measured after 48, 96, 120 and 144 hr.

Results

The diameter of each colony was measured along the two lines crossing each other at the centre. The observations for all the concentrations of the fungicides and the various fungi, in triplicate, were thus taken and the mean values with standard deviations calculated.

Inhibition percentage was calculated by substracting the growth obtained in various concentrations of a fungicide from that of controls.

The observations show that compound S-3 is more effective, about twice, than the imported Colloidal copper in completely checking the growth of *H. anomolum*. 0.8% of compound S-3 gives 100% inhibition as compared to colloidal copper where 1.6% is needed for obtaining the same results (Figs. 1 and 2).

Tables 1-4 showing the final observations after 144 hours have been presented with the mean standard deviations to economise space. Each mean is thus a mean of three triplicated experiments in itself (Table 1).

F. solani is inhibited by both compound S-3 and Colloidal copper at the same concentration of 1.6% (Table 2 and Figs. 3 and 4); while in case of other two fungi compound S-3 has proved to be somewhat less effective as compared to Colloidal copper in controlling the growth of both *A. tenuis* and *F. dimerum* (Tables 3 and 4, Figs. 5 and 6).

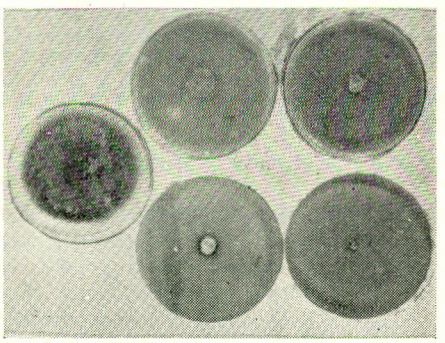

Fig. 1.—Effect of compound S-3 on *Helminthosporium anomalum*. Extreme Left Control; Top row 0.1%, 0.2%; Bottom row (L-R) 0.4%, 0.8% .

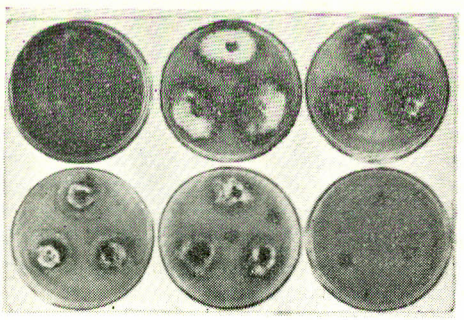

Fig. 2.—Effect of Colloidal copper on *Helminthosporium anomalum*. Top row (L-R) control, 0.1%, 0.2%; Bottom row (L-R) 0.4%, 0.8%, 1.6%.

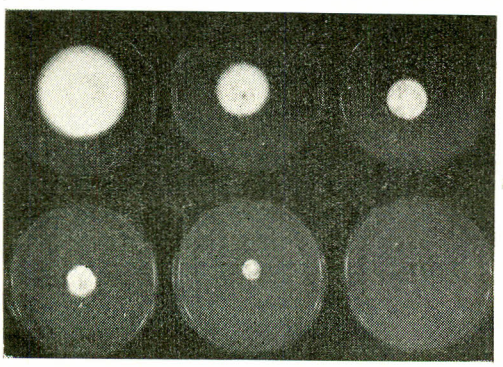

Fig. 3. –Effect of S-3 on *Fusarium Solani*. Top row (L-R) control, 0.1%, 0.2%; Bottom row (L-R) 0.4%, 0.8% 1.6%.

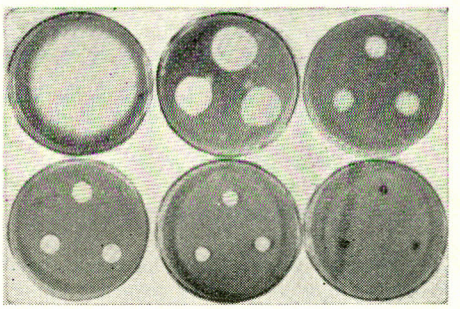

Fig. 4.—Effect of Colloidal copper on *Fusarium solani*. Top row (L-R) control 0.1 %, 0.2%; Bottom row (L-R) 0.4%, 0.8%, 1.6%

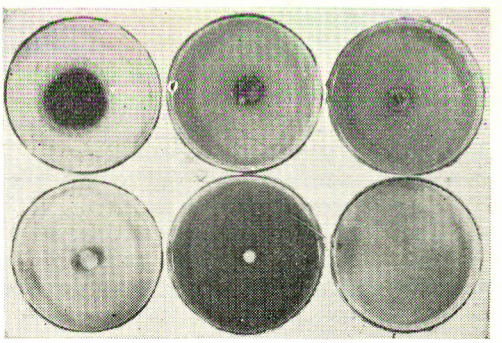

Fig. 5.—Effect of S-3 on *Alternaria tenuis*. Top row (L-R) control, 0.1%, 0.2% Bottom row (L-R) 0.4%, 0.8%, 1.6%

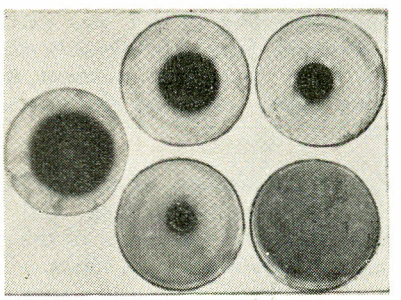

Fig. 6.—Fffect of Colloidal copper on *Alternaria tenuis*.
Extreme left control
Top row (L-R) 0.1%. 0.2%.
Bottom row (L-R) 0.4%, 0.8%

Discussion

Effectivity of a compound towards different genera of fungi and even towards the various species of the same genus often differs, as has also been reported by many workers.[8,9] Thus, in our studies we found that the new compound S-3 was twice as active against the growth of *H. anomalum* as compared to the imported Colloidal copper. However, equal concentrations of compound S-3 and Colloidal copper were needed to check the growth of *F. solani*. Compound S-3 was less effective than Colloidal copper in controlling the growth of *F. dimerum*. In case of

TABLE 1.—PERCENT INHIBITION OF *H. anomalum* GROWTH DUE TO S-3 COMPOUND AND COLLOIDAL COPPER, AFTER 144 HR AT ROOM TEMPERATURE.

Fungicide	Mean diameter of colonies (mm) with standard deviations % concentrations						
	0.05	0.1	0.2	0.4	0.8	1.6	Control
S-3 ..	—	22.66	17.66	11.00	—	—	75.00
		±0.98	±0.28	±1.00	—	—	±1.00
% Inhibition ..	—	69.78	76.40	85.33	100	100	0.00
Colloidal ..	47.33	37.66	30.00	25.33	14.66	—	77.00
copper ..	±0.48	±0.98	±1.00	±1.58	±0.02	—	±2.00
% Inhibition ..	38.53	51.09	61.03	67.10	80.98	100	0.00

TABLE 2.—PERCENT INHIBITION OF *F. Solani* GROWTH DUE TO COMPOUND S-3 AND COLLOIDAL COPPER AFTER 144 HR OF INCUBATION AT ROOM TEMPERATURE.

Fungicide	Mean diameter of colonies (mm) with standard deviation at various % concentrations						
	0.05	0.1	0.2	0.4	0.8	1.6	Control
S-3 ..	—	33.66	27.00	14.66	12.66	—	72.00
	—	±1.54	±2.73	±0.28	±0.28	—	±1.00
% Inhibition ..	—	53.23	62.50	79.63	82.26	100	0.00
Colloidal copper ..	47.00	37.66	23.33	16.33	12.66	—	74.00
	±2.65	±1.54	±1.51	±1.15	±1.52	—	±2.00
% Inhibition ..	36.48	49.10	68.47	77.93	82.89	100	0.00

TABLE 3.—PERCENT INHIBITION OF *A. tenuis* GROWTH DUE TO COMPOUND S-3 AND COLLOIDAL COPPER AFTER 144 HR AT ROOM TEMPERATURE.

Fungicide	Mean diameter of colonies (mm) with standard deviations % concentrations						
	0.05	0.1	0.2	0.4	0.8	1.6	Control
S-3 ..	—	23.33	25.00	16.50	9.00	—	50.66
	—	±1.52	±1.41	±1.50	±2.00	—	±4.16
% Inhibition ..	—	53.94	50.65	67.42	82.03	100	0.00
Colloidal ..	30.33	20.00	18.33	13.50	—	—	55.00
copper ..	±0.33	±1.00	±1.50	±0.86	—	—	±1.00
% Inhibition ..	44.85	63.45	66.67	75.45	100	100	0.00

TABLE 4.—PERCENT INHIBITION OF *F. dimerum* GROWTH DUE TO COMPOUND S-3 AND COLLOIDAL COPPER AFTER 144 HOURS AT ROOM TEMPERATURE.

Fungicide	Mean diameter of colonies (mm) with standard deviations % concentrations						
	0.05	0.1	0.2	0.4	0.8	1.6	Control
S-3 ..	—	36.33	35.33	21.33	10.30	—	63.66
	—	±2.51	±2.51	±1.17	±2.07	—	±2.31
% Inhibition	—	42.93	44.50	66.49	83.82	100	0.00
Colloidal ..	53.00	39.66	27.33	13.66	—	—	65.00
copper ..	±2.00	±2.08	±1.93	±1.15	—	—	±2.00
% Inhibition ..	18.46	38.98	57.95	78.98	100	100	0.00

A. tenuis too the new compound was comparatively less effective as compared to the Colloidal copper.

The growth obtained in various concentrations of compound S-3 with all the fungi mentioned above, specially at the higher concentrations was very scanty, discoloured, and deviod of the usual sporulation. Such changes were less marked in case of Colloidal copper.

Another characteristic feature of the compound S-3 was the absence of any contamination during the course of our experiments. However, contamination of *A. niger*, *A. flavus*, *Monilia* sp. and other bacterial species did occur with Colloidal copper even at the higher concentrations. This further proves the effectiveness of the new compound against the above-mentioned organisms also.

The emulsifier used for making the compound miscible was found to have negligible effect on fungal growth and thus does not add to the fungitoxicity of the compound S-3.

All these observations show that after some further improvements this new compound can be recommended as a future commercial fungicide.

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